

## Societal Assessment (Subject Editor: David Hunkeler)

# A Framework for Social Life Cycle Impact Assessment

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### Abstract

**Goal, Scope and Background.** To enhance the use of life cycle assessment (LCA) as a tool in business decision-making, a methodology for Social life cycle impact assessment (LCIA) is being developed. Social LCA aims at facilitating companies to conduct business in a socially responsible manner by providing information about the potential social impacts on people caused by the activities in the life cycle of their product. The development of the methodology has been guided by a business perspective accepting that companies, on the one hand, have responsibility for the people affected by their business activities, but, on the other hand, must also be able to compete and make profit in order to survive in the marketplace.

**Methods.** A combined, bottom-up and top-down approach has been taken in the development of the Social LCIA. Universal consensus documents regarding social issues as well as consideration for the specific business context of companies has guided the determination of damage categories, impact categories and category indicators.

**Results, Discussion, and Conclusion.** The main results are the following: (1) Impacts on people are naturally related to the conduct of the companies engaged in the life cycle rather than to the individual industrial processes, as is the case in Environmental LCA. Inventory analysis is therefore focused on the conduct of the companies engaged in the life cycle. A consequence of this view is that a key must be determined for relating the social profiles of the companies along the life cycle to the product. This need is not present in Environmental LCA, where we base the connection on the physical link which exists between process and product. (2) Boundaries of the product system are determined with respect to the influence that the product manufacturer exerts over the activities in the product chain. (3) A two-layer Social LCA method with an optional and an obligatory set of impact categories is suggested to ensure both societal and company relevance of the method. The obligatory set of impact categories encompasses the minimum expectations to a company conducting responsible business. (4) A new area of protection, *Human dignity and Well-being*, is defined and used to guide the modelling of impact chains. (5) The Universal Declaration of Human Rights serves as normative basis for Social LCA, together with local or country norms based on socio-economic development goals of individual countries. The International Labour Organisation's Conventions and Recommendations, and the Tripartite Declaration of Principles concerning Multinational Enterprises and Social Policy, support development of the impact pathway top-down, starting from the normative basis. (6) The obligatory part of Social LCA addresses the main stakeholder groups, employees, local community and society.

**Recommendations and Outlook.** Social LCA is still in its infancy and a number of further research tasks within this new area are identified.

**Keywords:** Framework, social LCIA; human rights; international labour organisation (ILO); social LCA; social LCIA; social responsibility

### Introduction

All over the world, companies make business decisions every day which affect people and environment, directly through their own operations, or indirectly through the value chain of their business. Increasingly, these companies are confronted with questions, e.g. from customers, consumer organisations and other NGOs, regarding their social performance. In several cases, which have reached the media, large multinational corporations have been held responsible for poor working conditions, not only in their own facilities, but also at their suppliers. Society's expectations to companies to assume a wider responsibility for the social impacts of their business activities is a challenge that has been accepted by companies that wish to conduct business in a more responsible way. Many companies, thus, see themselves in need of a tool which can help them make informed decisions about their social impacts throughout the life cycle of their products.

Life cycle assessment (LCA) has obtained a widespread use for decision support, but LCA traditionally only considers environmental impacts [1-3] and to some extent working environment impacts [4-6]. Therefore, recommendations based on LCA fail to address possible trade-offs between environmental protection and both social and economic concerns in the product life cycle. This raises questions about LCA's ability to support actual decision-making in companies, which aim for sustainability, and it creates an incentive for developing LCA methodology to include these other dimensions of sustainability. Life Cycle Costing (LCC) considers economic implications in a life cycle perspective and, after a relatively long history outside the scientific LCA community, it is attempted to be integrated into life cycle management (e.g. [7,8]); however, research carried out on Social LCA is still at an early stage and publications on the subject are quite limited. To mention a few of these is, one might consider the early SELCA [9], Casado Cañequer's work on development of social company performance indicators for

use in LCA [10], Life Cycle Working Time [11] and research conducted on an integrated approach for product assessment in connection with the Label 'Sustainable Development' [12]. More recent research includes SEEbalance by BASF [13] and PROSA by the German Öko-Institut [14].

It is the aim of the authors to contribute to this research by suggesting a framework for a Social life cycle impact assessment (LCIA) methodology. The article presents a method to define the issues for obligatory impact categories of Social LCA, whereas the indicators working within this framework will be presented in a later paper. The framework and the tools that follow it are intended to support informed business decisions in a company which aims at minimising harmful impacts on peoples' lives from the activities in the company's product chains. Focus is thus on those types of impacts that the company has a possibility to influence, and a premise for the developmental work is that the method does not question a company's fundamental right to conduct business and survive in the market (compete and gain profit), but focuses on the manner in which it conducts its business. The Social LCA is hence developed to facilitate companies to conduct business in a socially responsible manner. A framework developed from a societal perspective rather than a company perspective might thus look different.

In order to increase comparability and ultimately compatibility between Social and Environmental LCA, the framework known from the ISO standards for Environmental LCIA [15] has been used as inspiration and followed to the extent that it has proved to be meaningful and practical.

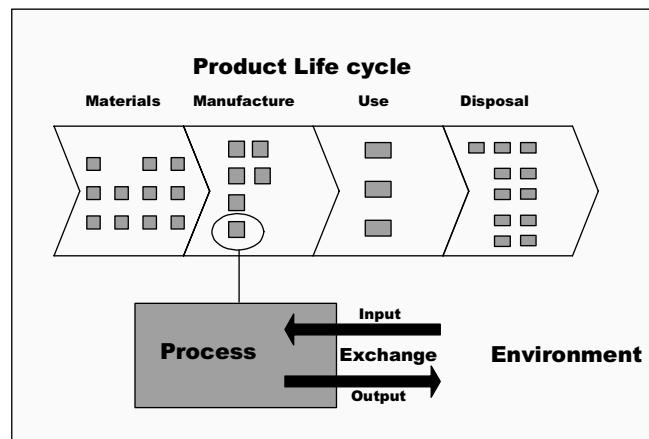
## 1 Product System Definition in Social LCA

The focus on social impacts rather than the environmental and resource impacts necessitate some deliberation of the way the product system is traditionally conceived and modelled, and how the impacts of the activities of the product life cycle are related to the functional unit of an LCA study.

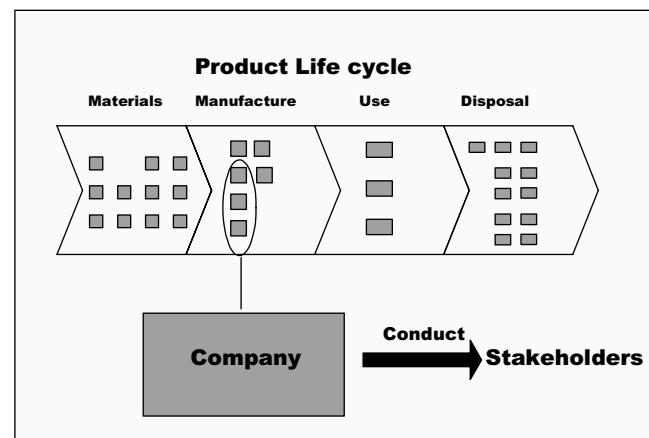
### 1.1 Conceptual understanding of the product system

The product system encompasses all the processes involved in the different stages of the product's life from the extraction of raw materials, through manufacture, use and maintenance, to the final disposal of the product. When the focus is on environmental impacts, there is a natural link between the physical input or output of a process and a change in quality of the surrounding environment. The performance of the processes is thus the main driver behind the product's environmental impacts, and Environmental LCA therefore identifies all relevant processes in the life cycle of a product and analyses their exchanges with the environment. See the conceptual outline of the product system in **Fig. 1**.

Social LCA is about impacts on people and, therefore, the focus must be on those activities in the life cycle which affect people. Here, it makes little sense to perform the analysis on a process level, since most impacts on people will be independent of the physical conditions of an industrial process, with the exception of some direct occupational health



**Fig. 1:** The product system as perceived and modelled in Environmental LCA. The product life cycle consists of processes (depicted as small blocks), which are each analysed individually and aggregated in the inventory



**Fig. 2:** The product system as perceived and modelled in Social LCA. The product life cycle is perceived as comprising a number of companies where industrial processes (depicted as small blocks) take place. The conduct of each company towards its stakeholders is analysed and aggregated in the inventory

impacts on workers<sup>1</sup>. Social impacts on people in the life cycle of a product have a more clear relation to the conduct of the companies involved in the product chain – and to the way the companies organise and manage their business. People affected directly or indirectly by the company's business activities may collectively be termed the stakeholders of the company. In the inventory step, the conduct of the company towards stakeholders is analysed, while the impact assessment addresses the impacts to these stakeholders as a result of the company's conduct. This perception of the product system is illustrated in **Fig. 2**. In this way, Social LCA involves a number of individual company assess-

<sup>1</sup> Environmental LCA considers occupational health impacts from direct exposure and, therefore, these need not be considered in Social LCA. Other occupational health impacts (e.g. psychological) are more dependent on organisational aspects and may thus also be analysed from an organisational point of view. Furthermore, when Social LCA has the purpose of improving social performance of a product and hence a company (following the line of thought presented here), it can also prove valuable to view occupational health from an organisational point of view, because it may indirectly give guidance to improvement.

ments which must be aggregated to produce the social life cycle profile of the product.

In the organizational perception of the product system in Social LCA, the use stage naturally falls out of place. Unlike in the other life cycle stages: the impacts on people cannot meaningfully be related to the conduct of one or several companies, but are related directly to the product use.

The direct and indirect social impacts derived from use of a product are often positive. If the social LCA is used for a social product profile, they should be included, but their inclusion gives rise to discussions about product justification and product benefits. A further elaboration of the characteristics of the use stage is presented in **Box 1**. Later in this article, we will suggest a basis for determining social company assessment parameters for all life cycle stages except the use stage, in recognition of the fundamental difference between this stage and the others.

#### **Box 1: A characterisation of the use stage in Social LCA**

The social impacts in the use stage occur when the product provides its service to the user, as specified in the functional unit of the LCA. When the LCA is used to compare different products fulfilling the same function, the social impacts in the use stage are often very similar (e.g. comparison of two types of washing powders for washing clothes), but when the comparison covers different product service systems with the same function (e.g. comparison of washing clothes by hand and in a machine), they may differ considerably and are therefore important to include. The types of social impacts are strongly dependent on the nature of the product. For example, the social impacts related to use of heart medicine are very different from those related to use of washing powder. Hence, it is suggested that assessment of the product's direct social impacts be carried out on a product category basis.

#### **1.2 Relating company impacts to the product and the functional unit**

A consequence of analysing impacts at a company level instead of process level is that the relation of the impacts to the product and thereby the product service is no longer straightforward. The link between a company's conduct in the product life cycle and the actual product is not direct and naturally quantifiable as the physical link between process and product which are the basis of Environmental LCA. Hence, to apply the organisational approach, it is necessary to develop a method to relate the social profiles of the suppliers, manufacturer and the waste management companies to the product in a meaningful manner.

A share factor is used to represent the weight that is given to a company's social profile in the aggregation of social impacts along the product chain, reflecting that company's importance in the overall life cycle. Importance can be determined in several ways, and there is not one obvious choice among them. To put emphasis on the activities in the life cycle, which involve most people, the number of working hours spent at the company per functional unit of the product could be used as a basis for determining the company's share factor. Alternatively, a focus on value creation along the product chain would require, for instance, that monetary input and output for each company or each life cycle stage be used as a basis. If a manageability approach is taken,

focus could be directed at those parts of the life cycle where the manufacturer has the largest influence, and the share factor could then be based on the material costs and product price for the company in the product chain. Other ways to calculate the share factor could be contrived, and the choice depends on two main criteria. Firstly, since the share factor inevitably introduces a bias in the assessment (as we know from the choice of allocation principle in Environmental LCA), it is important that this bias is known and accepted. Secondly, it is of utmost importance that the data or information needed for calculation of the share factor is available for all companies in the product chain, since the share factor is crucial for relating the individual company profiles to the product and hence for aggregating over the life cycle. Investigations of the different principles and their consequences for the results of the Social LCA are ongoing, and no choice has yet been made.

The social profile of the company can be more or less comprehensive depending on the choice of assessment parameters and the complexity of modelling. The framework operates with a number of different social impact categories which together give a covering impression of the company's social conduct. As suggested by Udo de Haes [16], a very simple social profile could be based on whether a company has obtained certification within the social area or not, but this approach is insufficient for the management decision support needed in our case.

#### **1.3 The boundaries of the product system**

A product life cycle can easily be described in general terms based on immediate knowledge about the product, e.g. activities in the life cycle of a cotton t-shirt involve the growing of cotton, processing of cotton, spinning, weaving, etc. In Environmental LCA, this information together with use of general process data can be used to make an LCA of the product. General information, as such, does not provide us with any useful information for carrying out Social LCA, because aspects of company conduct and related stakeholder impacts are, in principle, always specific. To assess the conduct of companies in the life cycle of the product, more specific information is needed. On the basis of information of geographical location and branch of industry, we may find information about what is commonly encountered company conduct in a certain area and in a certain branch, and on this basis make it probable, what is the conduct of the investigated company. However, the case may be that two companies producing the same product and located in the same region of a country have totally different social impacts, because of different management and therefore different conduct, for example towards employees, the local community and other stakeholders. While country or region-specific information about the product chain may enable a crude assessment, a conclusive assessment must be based on company-specific information for the most important companies in the product chain. In contrast to Environmental LCA, the Social LCA is highly site-specific in its data requirements, and the value of conducting Social LCA on the basis of generic product chains is normally limited. A similar conclusion has been presented by Vanhoutte et al. [12].

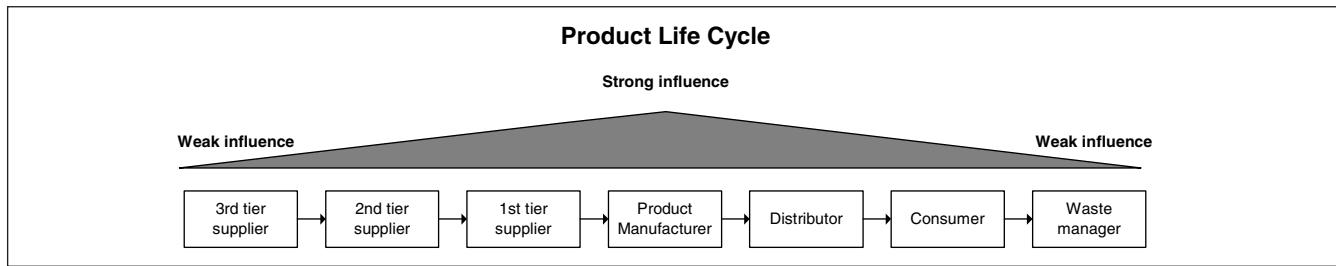


Fig. 3: The influence exerted by the product manufacturer varies along the product chain

The need for company specific information and data has consequences for the scoping of the product system in Social LCA, i.e. which parts of the product system need to be included. In order to obtain specific information from a company, it is crucial that the data collector has some influence to exert on it. Since the focus is on the application of Social LCA in business decision-making, the data collector is typically the manufacturer of the product. The further upstream or downstream the activities are located, the weaker the influence of the manufacturer will be as illustrated in Fig. 3. This decision support-perspective, thus, tends to narrow down the focus on the material stage and makes the relevance of the disposal stage debatable. The product system boundaries in Social LCA must be determined on a case-to-case basis, but some general thoughts are presented in the following.

**Material stage – Suppliers of commodities and services.** The product manufacturer exerts influence on the material stage of the life cycle, through choice of materials and services, and through selection of suppliers. The product manufacturer has influence on the conduct of the suppliers as a customer, but the further upstream, the more indirect and weak this influence becomes. In the material stage, the Social LCA has the strongest focus on the direct suppliers (first tier), but in some situations, important impacts lie further upstream and, here, the product manufacturer has to exert a more indirect influence through partnerships or through pressure on his own supplier. All relevant social impacts in the material stage are included in the Social LCA, and consideration of the first tier of suppliers is regarded as minimum.

**Manufacturing stage – Product manufacturer.** The product manufacturer of course exerts maximum influence in the manufacturing stage and has the benefit of unimpeded access to information about the interaction with stakeholders. Therefore, all relevant social impacts on stakeholders of the company are included in the Social LCA.

**Distribution – Product manufacturer or distributor.** The product manufacturer exerts direct influence in the distribution stage whether performed in house or outsourced. The social impacts of the distribution stage are included in the Social LCA at all times.

**Use stage – Consumers.** Social impacts of product use should be considered in Social LCA, typically on a product category level.

**Disposal stage – Waste management companies.** The social impacts of the disposal stage will depend on the local or regional community's choice of waste management companies and technologies, and the way in which these compa-

nies interact with their employees, the local community and other relevant stakeholders. The influence of the product manufacturer will usually be limited here. In addition, obtaining the needed information will require that product manufacturers track their products to specific waste management companies. While this may be feasible for a manufacturer who primarily produces for a local market, this level of information will be difficult to obtain for a manufacturer on a global market. An exception is the case where the manufacturer has a take back arrangement for used products, i.e. where he has influence on the choice of waste management companies, or where the manufacturer is also the end-user of the product. There are occupational health and safety impacts during waste handling which the manufacturer may help minimise through the design of the product. To the extent that these impacts are of a chemical nature, they may be included in Environmental LCA. In summary, the social impacts in the disposal stage are included in the Social LCA to the extent possible, but the product manufacturer generally has little influence on activities in this stage. Considering the number of processes, the related working hours and the value creation of the entire life cycle and of the disposal stage, it is fair to say that this stage comprises a rather small part of the product system and, even if the disposal stage is omitted, it is still the larger part of the life cycle that is covered.

**Transportation between stages.** Transport other than that associated with the distribution of the product must also be considered in Social LCA to the degree possible. The product manufacturer may exert influence on the transportation of materials from suppliers, which is why it must be included at all times. Transport between suppliers upstream to the 1<sup>st</sup> tier and transport to disposal locations downstream, however, is virtually out of the influence sphere of the product manufacturer and will be difficult to include.

## 2 Social Life Cycle Impact Assessment: From the Top or the Bottom?

A company defines its social responsibility through its actions or lack of action, whether these are intentional, unintentional or even unconscious. For Social LCA to support actual decision-making in companies leading to actions for improvement of social impact, it is essential that all relevant impacts are included, and that the link between a company's actions and the impact or damage they cause on people is clear and relatively certain. A Social LCA method will inevitably place a certain responsibility with a company through its choice of assessment parameters, i.e. category indicators, impact categories, and damage categories. This

means that this choice must be transparent, and fair in terms of the influence which it is possible for a company to exert. In a bottom-up approach, the definition of assessment parameters will start with an identification of social issues in the business context of the product manufacturer<sup>2</sup>. The company should not be held accountable for more than it possibly can influence and all impacts, which are relevant from the company's point of view, should be considered. This can be achieved by a bottom-up approach. In a top-down approach, the definition of assessment parameters starts with an identification of what is valuable to society. This ensures an inclusion of those impacts which are relevant from a societal point of view<sup>3</sup>, but the relevance to the company's decision-making is not always straightforward, and sometimes it is completely absent.

Our choice to focus on the application of Social LCA in a company's decision-making process favours a bottom-up approach starting from the business context of the product manufacturer. Such an approach implicitly demands great flexibility of the method to ensure that relevant impacts from the company's point of view are included. On the other hand, we would like to avoid that the choice of assessment parameters becomes a random and inconsistent selection based on availability of data and on what companies wish to be held accountable for, rather than on what is most essential for the objective of reducing harmful and promoting beneficial impacts on people. It is crucial for the legitimacy of the Social LCA that it is normative and therefore consensus-seeking in its approach, making value-judgements transparent and accepted in the definition of category indicators, impact and damage categories. In order to ensure both societal and company relevance of the method, a two-layer LCA method is suggested.

## 2.1 Two-layer social LCA

For Social LCA to support the decision-making process in a company, it must adapt to the specific context of this company's operation, for example by considering impacts which are specific to the product or sector of industry and to the company itself. The company may thus wish to determine social assessment parameters based on dialogue with stakeholders, based on specific concerns, on corporate values and/or on principles for conducting business, on responsibility that may inherently be associated with the product (e.g. medicine, tobacco, organic foods), etc. From a legitimacy point of view, the methodology should include social

<sup>2</sup> In traditional LCA, the bottom-up or midpoint approach (sometimes referred to as 'environmental theme approach') is based on known and acknowledged environmental problems as categories of impact. The approach starts from the environmental exchanges between the product system and the surroundings, and these are taken as input to models of the environmental impact chain which underly the environmental problem. Given the acceptance of such categories in decision-making, the results, expressed in terms of midpoint variables, can be regarded as relevant for decision-making [3]. Environmental LCIA frameworks based on the traditional bottom-up approach are, for example, EDIP97 [4] and CML2001 [1].

<sup>3</sup> Examples of Environmental LCIA frameworks based on a top-down approach (sometimes referred to as 'damage approach') are Eco-Indicator 99 [2] and EPS [17].

Two-layer Social LCA	Optional	Self-determined, context-specific assessment parameters to customise Social LCA
	Obligatory	Consensus-driven, 'normative' assessment parameters expressing minimum requirements to business

**Fig. 4:** The two-layer structure of Social LCA designed to accommodate customisation of Social LCA while maintaining a general core

assessment parameters that express some minimum expectations to conduct responsible business.

The Social LCA thus consists of two layers of impact categories, an obligatory, normative, predetermined set of categories expressing minimum expectations to conducting responsible business, and an optional, self-determined set of categories expressing interests specific to the product manufacturer to the extent that these are not already covered by the predetermined impact categories (Fig. 4). In this way, Social LCA will consist of a normative core, but with an option to customise it to serve internal company purposes.

## 2.2 Combined top-down bottom-up approach

In the development of the obligatory part of the framework, it was experienced, when it came to modelling the impacts, that the top-down approach had to be combined with a bottom-up approach due to the difficulties in creating a quantitative relationship between the 'damage level' and the company's activities in the product system. The top-down approach was applied to define the relevant issues for the definition of impact categories (see Section 4), i.e. to identify what we wish to protect and promote with our social LCA method and which social values lie behind this choice – to define what 'social' means in the context of a life cycle assessment. This has resulted in definition of an area of protection (see Section 3). At the same time, the impact chain from the level of the product system activities (common business processes) towards the defined impact categories was traced in the bottom-up approach (see Section 5). The combination of the two approaches ensures both the connection to the inventory level and the relevance on the societal level. The development of the obligatory part of the Social LCIA framework is presented in the following sections.

## 3 Areas of Protection

In Environmental LCA, the assessment addresses impacts on and damages to the quality of the surrounding environment. Hence the term 'Area of protection', is used to express what is of value to human society, and must therefore be protected by LCA through the consideration of what causes damage to it. In Social LCA, a company's activities may result in positive impacts (injection of capital in a local community in a developing country, job creation, etc.) on the stakeholders as well as negative impacts (indecent working conditions, exploitation of local natural resources, etc.). In social LCIA, areas of protection are thus used to express what is of direct value to human society, and therefore must be protected *and promoted* by LCA through consideration of what causes damage *and benefit* to these areas.

### 3.1 Existing areas of protection

Areas of protection have already been defined in Environmental LCA, but their relevance and sufficiency to Social LCA is questionable, given that they have been defined in an environmental context. Most LCA methodology publications refer to four areas of protection, *Human Health*, *Natural Environment* and *Natural Resources*, which are also applied by ISO [15], and *Man-made Environment*, which was recommended as best practice in 1999 [18] (Table 1)<sup>4</sup>.

**Table 1:** Areas of protection and underlying societal values in Environmental LCA [18]

Areas of protection	Societal values
Human health	Intrinsic value of human life, economic value
Natural environment	Intrinsic value of nature (ecosystems, species), economic value of life support functions
Natural resources	Economic and intrinsic values
Man-made environment	Cultural, economic, and intrinsic values

The identification of these four areas of protection does not originate from a discussion of societal values, as one might expect from the description, but may be seen as a corollary to a bottom-up approach, which has been guided by the conceived damage of environmental impacts such as acidification, global warming, etc.<sup>5</sup> [21,22]. As a natural consequence, social impacts and related damages are not considered. Even though there may be an overlap between what should be protected in Social and Environmental LCA, because environmental impacts may lead to damage on some of the same areas of protection as social impacts, new areas of protection or a redefinition of the existing must also be considered in the Social LCIA to fully include the Social Dimension.

### 3.2 Areas of protection in social LCA

What do we wish to protect and promote with our Social LCA method? Social LCA is about people and impact on people, social impacts, whereas Environmental LCA is about impact on the biophysical environment. As discussed in the previous section, Environmental LCA only considers damage on people, which occurs as a consequence of impacts on the environment. The area of protection, *Human Health*, is described as the intrinsic value of human life, and damage to this area of protection is defined as a mere question of mortality and morbidity [19]. Social LCA should embrace a broader understanding of human life, encompassing the value of a good and decent life, to be able to truly consider social impacts and damage to people. At least three important prerequisites for a good and decent life can be identified, 'hu-

man health', to live a healthy and naturally long life; 'human dignity', to live a decent life and enjoy respect and social membership; 'basic needs fulfilment', to have access to food, water, clothes, medical care, etc. These prerequisites are interrelated as human health and, in many cases, human dignity, are promoted by, and even dependent on, fulfilment of basic needs. In keeping with this, a new area of protection is suggested, *Human Dignity and Well-being*.

With the interrelationship between human dignity, human health and basic need fulfilment in mind, *Human Dignity and Well-being* should be regarded as complementary to the existing areas of protection. Overlaps may occur between the *Human Health* area of protection in Environmental LCA and *Human Dignity and Well-being*. The proposed new area of protection may not be the only relevant area of protection in Social LCA, but it is proposed because of its obvious connection to impacts on people. In the future development, it is relevant to consider whether the area's protection for Social and Environmental LCA should be integrated. Considering the overlaps between the suggested *Human Dignity and Well-being* and the existing *Human Health*, this seems a natural next step.

## 4 From the Top and Down: Development of the Obligatory Part of the Social LCA Framework

In order to apply the area of protection in a further development of the Social LCIA framework, a more explicit definition of the meaning of 'protection and promotion of human dignity and well-being' is needed. For a broader acceptance of the Social LCA methodology, it is chosen, to the extent possible, to draw upon international agreements that reflect a broader understanding, representative for our global community. This is also in accordance with the recommendation given by ISO for Environmental LCIA methods that 'the impact categories, category indicators and characterization models should be internationally accepted, i.e. based on an international agreement or approved by a competent international body' [23].

### 4.1 Universal Norms

The Universal Declaration of Human Rights (UDHR) [24] was the first document in history, considered to have universal validity, to be adopted by an international organisation such as the United Nations<sup>6</sup> [26]. The UDHR expresses the fundamental human rights as a way to protect and promote human dignity and well-being. It was elaborated in recognition that the 'inherent dignity of all members of the human family is the foundation of freedom, justice and peace in the world', and in the preamble to the UDHR, the fundamental human rights are motivated by: "Whereas the peoples of the United Nations have in the Charter reaffirmed their faith in fundamental human rights, in the dignity and worth of the human person and in the equal rights of men and women and have determined to promote social progress and better standards of life in larger freedom,..."

<sup>4</sup> Definitions of these areas of protection and an additional one, *Life Support Function*, have been subject to discussions over the years in the international LCA community, and a consensus has not yet been established [3,19].

<sup>5</sup> In later discussions about the inclusion of *Man-made environment*, the argument about its policy-relevance, however, has also been brought forward [20].

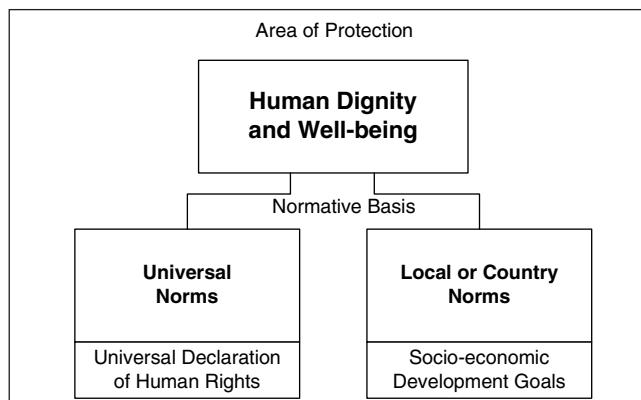
<sup>6</sup> The United Nations was formed by 58 member states at that time of the adoption. Today, the organisation has 191 members, which have signed the Universal Declaration of Human Rights. [25,26]

Furthermore, the UDHR fulfils two important criteria to serve as a normative basis for Social LCIA. It is the result of an international consensus process, and its fundamental validity has been established in practice through inspiring the creation of legally binding human rights treaties<sup>7</sup>. A similar approach to use international conventions, treaties and laws as basis for value judgements in LCA has been suggested by Volkwein & Klöpffer (1996) [27] in relation to the valuation step in LCA.

#### 4.2 Local or country relevant norms

What is conceived as damaging or beneficial for the human dignity and well-being in a society is also influenced by its culture, and political and socio-economic stage of development. In addition to the fundamental human rights, there are thus also society specific conditions, which are relevant for the perception of what is damaging and beneficial for the protection and promotion of the human dignity and well-being. Consequently, it is not sufficient only to rest on the universal norms in Social LCIA. In addition, local or national norms must be considered.

Human dignity and well-being is threatened if a minimum of material welfare is not present. Protection and promotion of human dignity and well-being is therefore also closely related to the positive or negative influence on the economic, social and political development of the country or society. Social LCIA must be able to take into account that many developing countries are at another level of development than industrialised countries, a level where stimulation of economic growth and social progress is essential for achieving better conditions of life and thereby human dignity and well-being, as well as observance of human rights. Consequently, it is necessary to consider the socio-economic and political problems on a country or regional basis to determine some of the relevant issues for Social LCA, the local or country relevant norms (Fig. 5).



**Fig. 5:** Proposed normative basis for the obligatory part of social life cycle impact assessment with Human Dignity and well-being as an area of protection

<sup>7</sup> UDHR is not a legally binding document, but it has inspired more than 60 human rights instruments which together constitute an international standard of human rights. For example, the International Covenant on Economic, Social and Cultural Rights and the International Covenant on Civil and Political Rights, both of which are legally binding [25].

#### 5 Establishing Impact Pathways in the Obligatory Part of the Social LCA Framework

After establishing the normative basis of Social LCA, the impact pathways from the area of protection to the midpoint level must be established. For this purpose, the Conventions and Recommendations of the International Labour Organisation and the Tripartite Declaration of Principles concerning Multinational Enterprises and Social Policy are used as universal norms. The local or country norms must be determined based on an analysis of the cultural and socio-economic issues of the relevant country, region, or local community.

##### 5.1 Universal norms

**ILO Conventions.** The International Labour Organisation (ILO) is a UN organisation. The ILO formulates international labour standards in the form of Conventions and Recommendations setting minimum standards of basic labour rights in a tripartite process with representation of government, employers and workers [28]. The ILO has both inspired, and been inspired by, the UDHR. The ILO Conventions and Recommendations are the interpretation of human rights in a labour market context and they therefore define the responsibility, as regards observance of human rights, which rightfully can be placed with companies. The relationship between the management and the employees is central for the dignity and well-being of employees, not only as workers, but also as individuals and members of society. Fundamental worker's rights offer clear guidelines on how employees should be treated irrespective of the country of operation.

The ILO Conventions and Recommendations consider a broad scope of worker's rights issues, whereof eight are considered fundamental (Table 2). There are some Conventions and Recommendations, which are directed at specific occupations, e.g. working at sea, in plantations, with machines, and these should of course be considered when dealing with these specific types of businesses. Other more general Conventions and Recommendations consider subjects like minimum wage, limitation of working hours, and health and safety of employees.

**Table 2:** Eight ILO Conventions have been identified by the ILO's Governing Body as being fundamental to the rights of human beings at work [28]

Issue	Convention
Freedom of association and collective bargaining	Freedom of Association and Protection of the Right to Organize Convention (No. 87) Right to Organize and Collective Bargaining Convention (No. 98)
The abolition of forced labour	Forced Labour Convention (No. 29) Abolition of Forced Labour Convention (No. 105)
Equality	Discrimination (Employment and Occupation) Convention (No. 111) Equal Remuneration Convention (No. 100)
The elimination of child labour	Minimum Age Convention (No. 138) Worst Forms of Child Labour Convention (No. 182)

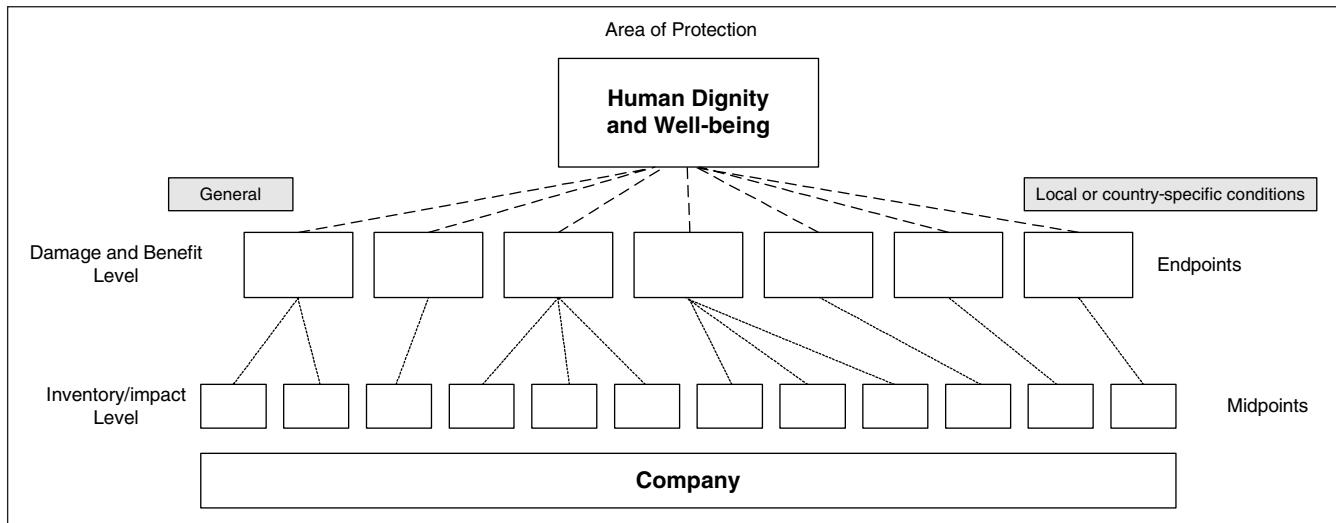


Fig. 6: The impact model of the Social LCIA framework

In the development of the Social LCIA framework, the ILO Conventions and Recommendations have been used to create a qualitative pathway top-down from the area of protection towards the midpoint, companies' impacts on employees. They have thus been used to define impact categories and category indicators by guiding what the indicators shall represent and how they shall do it (moving top-down in Fig. 6).

The ILO Conventions are aimed at implementation at state level and hence not formulated to address the business activities of companies. Therefore, indicators addressing the concerns of the ILO Conventions and Recommendations have been developed (in what may be perceived as a bottom-up approach), starting from the general business processes which take place in companies, e.g. the hiring of new workers.

An overview of the impact pathway model applied in the Social LCIA is presented in Fig. 6.

**Tripartite Declaration of Principles concerning Multinational Enterprises and Social Policy.** A company may benefit human dignity and well-being by stimulating the socio-economic development, which increases welfare for people in the local community. This impact of the company on local community is thus more indirect than on the internal stakeholders. On a national level, the company may also

impact on the area of protection indirectly through its stimulation of economic and social development in society.

Besides giving guidance based on the ILO Conventions and Recommendations, the Tripartite Declaration emphasizes the role of companies in regard to promotion of economic and social welfare in developing countries. Their activities should be in harmony with the development priorities and the social aims and structure of the country in which they operate [29,30].

The issues considered by the Tripartite Declaration in guidance of companies operating in developing countries are described in Table 3. Similar to the indicators based on the ILO Conventions and Recommendations, the relevant articles of the Tripartite Declaration have been used to guide the content and positive direction of indicators in the Social LCIA.

## 5.2 Local or country relevant norms

To establish local or country norms, it is recommended to start from National or Regional Human Development Reports published by the United Nations Development Programme (UNDP) or similar publications providing information about the socio-economic development of countries.

Table 3: Excerpt of the principles of The Tripartite Declaration of Principles concerning Multinational Enterprises and Social Policy regarding companies operating in developing countries [29,30]. Numbers in brackets in second column refers to article number of the Declaration

Issue	Principle of conduct
Job creation	Increase employment opportunities and standards (16)
Local/national recruitment in developing countries	Use of national labour (18)
Generation of employment and technology development	Use technologies that generate employment and take part in development of new technology in host countries (19)
Stimulation of economic growth in developing countries	Use of national suppliers (20)
Stability of employment	Ensure stability of employment through effective manpower planning (25)
Skill formation and development	Strive to raise education and skill level of employees in developing countries (31)
Wages, benefits and conditions of work	Ensure best possible within the framework of government policies (34)

Corruption and bribery, payment of income tax, prevention of illiteracy and contribution to health care, e.g. in areas where HIV/AIDS causes big societal problems, are all examples of important topics which cannot be ignored when doing business certain places in the world. These and other similar topics may be considered under local or country-relevant norms in obligatory Social LCA.

### 5.3 Implications of the suggested framework

**Impacts on stakeholders.** The stakeholder relations of a company are very specific and can be quite complex, which makes it difficult to make a general people impact model based on them. The normative approach in the Social LCIA results in a simplified stakeholder impact model for companies, considering only three main stakeholder groups, employees, and local community and society. The people impact spheres of a company engaged in the life cycle of a product, as conceived in the obligatory part of the Social LCA, are illustrated in Fig. 7. When moving from the centre towards the periphery in the figure, the company's impact on people becomes more indirect. Impacts internally in the company (the inner sphere in Fig. 7) can also give rise to impacts in the local community or the society, although more indirectly. The possibility to customise Social LCA (optional part) enables inclusion of impacts on other relevant stakeholders.

**New perception of LCIA elements and challenges.** In the proposed framework for Social LCA there is no traditional characterisation step. The characterisation model in Environmental LCA serves the purpose of quantitatively translating the life cycle inventory results into environmental impacts as represented by the category indicator scores. In Social LCA, the category indicators are developed to measure the social impacts directly at the company. The process of developing the indicators on the basis of the ILO Conventions and Recommendations and the Tripartite Declara-

tion, which also include elements of assessment, can be regarded as equivalent to the modelling of impact indicators in the characterisation modelling of Environmental LCA. The impacts in Social LCA are very site-specific. This means that the indicator score is determined not only by the behaviour of the company, but also of the locally-determined risk that the behaviour of the company will lead to actual damage to the area of protection.

Social LCA is also distinguished from Environmental LCA by including elements of assessment in the inventory through the use of qualitative indicators. This fact poses larger requirements to LCA practitioners and practitioner manuals to give specific guidance on the use of indicators to ensure uniform assessment.

## 6 Conclusions

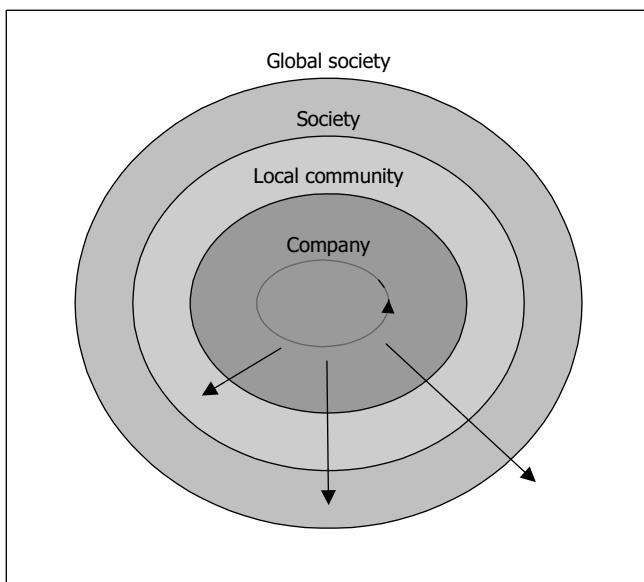
This article has presented a framework for Social LCA with a focus on legitimacy (through its foundation in universal norms) and company relevance. The framework covers the entire life cycle of a product with emphasis on the stages where the company has the largest influence, the materials and product manufacturing stages.

To accommodate the extended perspective compared to Environmental LCA, a new area of protection, *Human Dignity and Well-being*, has been proposed, and social impacts have been defined as impacts that ultimately will result in damage or benefit for this area of protection.

Contrary to the process-approach taken in Environmental LCIA, an organisational approach is taken when defining the product system, because social impacts are generally determined by the conduct of the companies which are engaged in the life cycle. The organisational approach requires a method to relate the social profiles of the companies involved in the life cycle to the product, and research is needed to analyse and test alternative methods.

The Social LCA framework consists of two layers of impact categories, an obligatory and an optional. The two-layer framework is suggested in recognition of the observation that many important social impacts of companies will be dependent on the specific business context, in terms of who are affected by the business activities and how they are affected. Hence, for Social LCA to be valuable as a decision support tool, the framework must enable inclusion of special concerns. On the other hand, there are some social impacts which are relevant to address for all companies and which must be considered by Social LCA in order to ultimately serve the objective of reducing harmful impacts and promoting beneficial impacts on people.

The framework is still under development, and even though some impact categories and indicators have been developed and tested on industry cases with success, full operationalisation with normalisation, weighting and aggregation has not yet been accomplished. The often more qualitative approach, necessary to assess violations of workers rights, for example, challenges the very essential elements of traditional LCA, normalisation and aggregation across impact categories. Further research in this area is necessary to succeed with the presented framework. It has not yet been attempted to establish a



**Fig. 7:** The impact from life cycle companies on key stakeholders as conceived in the obligatory part of the Social LCA. The approach is a simplified stakeholder impact model. The arrows illustrate the social impacts of the company on stakeholders internally or externally

quantitative link between impact and damage, i.e. to model actual damages caused by the companies' conduct. Where possible, this will support weighting of the impact categories and provide information of obvious relevance for society.

Further work with the establishment of local and country norms is necessary for Social LCA to give a covering image of the social impacts through use in business decision-making and to help it to reflect impacts which raise living standard in some parts of the world and thereby promote human dignity and well-being.

Social LCA holds the potential of promoting economic and social welfare in developing countries and improving working conditions around the world by providing responsible companies with a tool to assess the social impacts in the product chain of their business activities. In addition, it may also make LCA a more interesting and relevant tool for companies in developing economies by supporting inclusion of the beneficial sides of economic development, where Environmental LCA focuses on the damages which the development typically causes to the environment.

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## References

- [1] Guinée JB (ed) (2001): *Handbook on Life Cycle Assessment: Operational Guide to the ISO Standards*. Kluwer Academic Publishers. The Netherlands, 2001
- [2] Goedkoop M, Efting S, Collignon M (2000): *The Eco-indicator 99 – A damage oriented method for Life Cycle Impact Assessment. Manual for Designers*. Second edition 17-4-2000. PRé Consultants. B.V., Amersfoort, The Netherlands, 2000
- [3] Udo de Haes HA, Jolliet O, Finnveden G, Goedkoop M, Hauschild M, Hertwich E, Hofstetter P, Klöpffer W, Krewitt W, Lindeier E, Mueller-Wenk R, Olsen S, Pennington D, Potting J, Steen B (eds) (2002): *Life Cycle Impact Assessment: Striving Towards Best Practice*. SETAC, Pensacola, USA, 2002
- [4] Wenzel H, Hauschild M, Alting L (1997): *Environmental Assessment of Products. Vol. 1 – Methodology, tools and case studies in product development*. First edition. Chapman & Hall, United Kingdom, Kluwer Academic Publishers, Hingham, MA, USA, 1997
- [5] Antonsson A, Carlsson H (1995): *The Basis for a Method to Integrate Work Environment in Life Cycle Assessments*. *J Cleaner Prod* Vol. 3 (4) 215–220
- [6] Schmidt A, Brunn Poulsen P, Poulsen K, Fløe T, Andreasen J (2004): *LCA and the Working Environment*. Environmental Project No. 907 2004. Danish Environmental Protection Agency, Danish Ministry of the Environment, 2004
- [7] Rebitzer G, Hunkeler D (2004): *Life Cycle Costing in LCM: Ambitions, Opportunities, and Limitations. Discussing a Framework*. *Int J LCA* 8 (5) 253–256
- [8] Norris GA (2001): *Integrating Life Cycle Cost Analysis and LCA*. *Int J LCA* 6 (2) 118–120
- [9] O'Brian M, Doig A, Clift R (1996): *Social and Environmental Life Cycle Assessment (SELCA)*. *Int J LCA* 1 (4) 231–237
- [10] Casado Cañequer F (2002): *Evaluación de la situación laboral de empresas: El análisis del ciclo de vida como herramienta para el desarrollo sostenible*. Ph.D. thesis, Universitat de Barcelona, Divisió de Ciències Jurídiques, Econòmiques i Socials, Barcelona
- [11] Wolf MA, Kupfer T, Baitz M (2001): *Life Cycle Sustainability – R&D of biosource based polymers*. Institute for Polymer Testing and Polymer Science (IKP), Dept. Life Cycle Engineering, Stuttgart, Germany. The Fifth Conference on Ecomaterials, Hawaii, USA, November 2001
- [12] Vanhoutte G, Heyerick A, Mazijn B, Spillemaeckers S, Vanbraeckel D (2004): *Ecological, social and environmental aspects of integrated product policy – development of two instruments (Report)*. Ugent-CDO and Ethibel
- [13] Saling P, Maisch R, Silvani M, König N (2005): *Assessing the Environmental-Hazard Potential for Life Cycle Assessment, Eco-Efficiency and SEBlalance®*. *Int J LCA* 10 (5) <DOI: <http://dx.doi.org/10.1063/lca2005.08.220>>
- [14] Grieshammer R (2004): *Substance und Product Chain Management supported by the method PROSA*. Öko-Institut. Presentation on the congress 'Sustainable Chemistry – Integrated Management of Chemicals, Products and Processes', Germany, January 27–29, 2004
- [15] ISO (1997): *Environmental Management – Life Cycle Assessment – Principles and Guidelines*. ISO 14040, International Organization for Standardisation, Geneva, Switzerland, 1997
- [16] Udo de Haes HA (2005): Personal Communication. SETAC Europe 15<sup>th</sup> Annual Meeting, France, Lille, May 2005
- [17] Steen B, Ryding SO (1992): *The EPS Enviro-accounting Method*. Swedish Research Institute, Federation of Swedish Industries. Göteborg, Sweden
- [18] Udo de Haes HA, Jolliet O, Finnveden G, Hauschild M, Krewitt W, Müller-Wenk R (1999): *Best Available Practice Regarding Impact Categories and Category Indicators in Life Cycle Impact Assessment*. Background document for the second working group (WIA-2) on Life Cycle Impact Assessment of SETAC-Europe. *Int J LCA* 4 (2) 66–74 & *Int J LCA* 4 (3) 167–174
- [19] Jolliet O, Brent A, Goedkoop M, Itsuno N, Mueller-Wenk R, Peña C, Schenk R, Stewart M, Weidema B, with contributions from Bare J, Heijungs R, Pennington D, Rebitzer G, Suppen N and Udo de Haes H (2003): *Final Report of the Lcia Definition Study*. Reviewed and final version from 24.12.2003. Life Cycle Impact Assessment Programme of the Life Cycle Initiative. UNEP-SETAC. Download from <[http://www.unep-etc.org/pc/sustain/lciinitiative/lcia\\_program.htm](http://www.unep-etc.org/pc/sustain/lciinitiative/lcia_program.htm)> in July 2004
- [20] Udo de Haes HA (1999): *Man-made Environment and Generic Application Dependency*. Gate to EHS: Global LCA Village, September 1999, pp 1–2
- [21] SETAC (1993): *A Conceptual Framework for Life-cycle Impact Assessment*. SETAC Workshop held in Sandestin, Florida, USA, 1–7 February 1992. Pensacola, USA
- [22] SETAC (1993): *Guidelines for Life-cycle Assessment: A 'code of practice'*. SETAC Workshop held at Sesimbra, Portugal 31 March–3 April 1993. Brussels, Belgium
- [23] ISO (2000): *Environmental Management – Life Cycle Assessment – Life Cycle Impact Assessment*. ISO 14042, International Organization for Standardisation, Geneva, Switzerland
- [24] United Nations (1948): *Universal Declaration of Human Rights*. Adopted and proclaimed by the General Assembly of the United Nations. December 10, 1948
- [25] United Nations (2003): <[www.un.org](http://www.un.org)>
- [26] UNHCHR (1997): *United Nations High Commissioner for Human Rights (1997): The Universal Declaration of Human Rights: A Magna Carta for all humanity*. United Nations Department of Public Information DPI/1937/A. December 1997
- [27] Volkwein S, Klöpffer W (1996): *The Valuation Step within LCA – Part I: General principles*. *Int J LCA* 1 (1) 36–39
- [28] International Labour Organisation: *Conventions and Recommendations*. ILOLEX. <[www.ilo.org](http://www.ilo.org)>
- [29] International Labour Organisation (2001): *Tripartite Declaration of Principles Concerning Multinational Enterprises and Social Policy*. Third edition. International Labour Office. Geneva, Switzerland
- [30] International Labour Organisation (2002): *A guide to the Tripartite Declaration of Principles Concerning Multinational Enterprises and Social Policy – Knowing and using universal guidelines for social responsibility*. International Labour Office – Multinational Enterprises Programme. Geneva, Switzerland

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